The Digital Dollar Project

Exploring a US CBDC

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DIGITAL DOLLAR FOUNDATION

accenture

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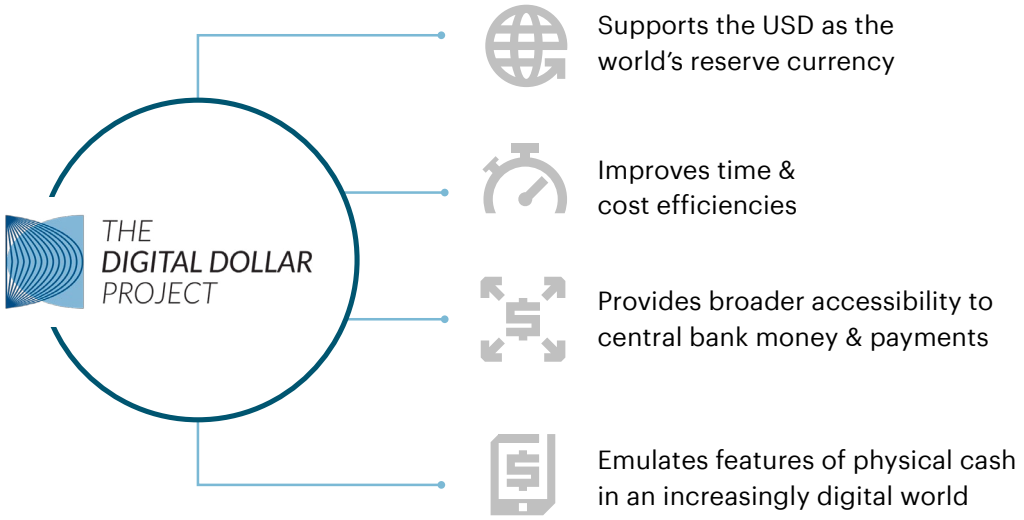
The road to a US digital dollar

What is the Digital Dollar Project?

The Digital Dollar Project (Project) is a partnership between the Digital Dollar Foundation (Foundation), a not-for-profit organization, and Accenture (NYSE: ACN) to advance the exploration of a central bank digital currency (CBDC)—or a "digital dollar." The purpose of the Project is to encourage research and public discussion on the potential advantages of a tokenized dollar, convene private sector thought leaders and actors, and propose possible models to support the public sector as it considers development, testing, and adoption of a CBDC.

The Project seeks to advance the public interest by future-proofing the dollar for consumers and institutions across both domestic and global economies. Given the US dollar's status as the world's primary reserve currency and exploration of CBDC by other national governments and stakeholder organizations, the Digital Dollar Project sees piloting a US digital dollar across a range of use cases as a critical and prudent initiative for the United States to begin now. The Project views the infrastructure underpinning the US dollar as a critically important public good and believes that upgrading this infrastructure will provide current and future generations enhanced flexibility, optionality, stability, and prosperity.



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The Foundation has engaged Accenture as lead architect and technology innovation partner. Globally, Accenture's CBDC work includes engagements with the Bank of Canada, the Monetary Authority of Singapore, the European Central Bank, and, most recently, Sweden's Riksbank.

To gain diverse perspectives from key stakeholders, the Digital Dollar Project has formed an advisory group that includes a broad array of economists, business leaders, technologists, innovators, lawyers, academics, and consumer advocates. The members range across the social and political spectrum. The Advisory Group has conducted several virtual meetings and provided thoughtful insight to the Project, including to the content of this white paper.[1]

Going forward, the Project will further explore design options, real-world pilots, and approaches for creating a digital dollar through a deliberative process that includes stakeholder meetings, roundtable discussions, and open forums.

[1]The views expressed in this white paper are those of the authors and do not necessarily represent the views of the Advisory Group or its individual members.

Introduction

Throughout its history, the United States has been a leader in innovation and building systems for the next generation. Whether launching the space program or building the Internet, US technological initiatives are typically undertaken through a series of partnerships between the private and public sectors. These endeavors incorporate and reflect longstanding US values of economic stability, technological innovation, individual liberty and privacy, free enterprise, and the rule of law.

A new technological age is unfolding, bringing with it the digitization of things of value that can be tokenized, programmable, and decentralized. Across the globe, governments and private entities are experimenting with tokenized commodities, contracts, legal titles and, most critically, commercial and central bank digital currencies. This wave of digital currency innovation is still gaining momentum. The questions for the United States are what role it will play in this innovation and to what degree will its core values be brought to bear.

We believe the United States should take a leadership role in this new innovation. The launch of a tokenized digital dollar is a logical and critical next step to future-proof the dollar and enshrine its democratic values in the future of money.

Successfully creating a digital dollar will be an enormous undertaking that should be done carefully, in a thoughtful and deliberative fashion. The critical monetary and public policy imperatives of the public sector should combine with the knowhow, ingenuity, and dynamism of the private sector.

While CBDC is a relatively new concept, we believe there is enough research and evidence to support a champion-challenger approach. The Project will explore the thesis that a tokenized US dollar will provide societal and economic benefits but continue to identify challenges and the merits of alternative models. The Project's "champion" model is a tokenized form of the US dollar that:

- **operates alongside existing monies**
- **is primarily distributed through the existing two-tiered architecture of commercial banks and regulated money transmitters**
- **is recorded on new transactional infrastructure, potentially informed by distributed ledger technology**

While existing electronic payment mechanisms work on an account-based model, our champion model of a digital dollar differentiates itself through its nature as a token, combining cash-like properties with many of the benefits of the existing account-based payment mechanisms. This paper will flesh out the rationale for a tokenized digital dollar that would not only maintain the economic stability of today's US dollar, but also offer the potential for new market opportunities, broader accessibility, reduced costs, and increased efficiencies.

To test our hypotheses and ensure tokenization solves real-world problems with anticipated benefits, the Project will continually consider "challenger" models depicting alternative approaches to modernizing monetary and payments infrastructure. This can be done through a series of real-world pilots that explore application across retail, wholesale, and international use cases.

TENETS OF A DIGITAL DOLLAR

The following characteristics are part of the Digital Dollar Project's champion model:

Tokenization: A digital dollar will be a tokenized form of the US dollar

Third format of currency: A digital dollar will operate alongside existing fiat currency and commercial bank money. It will mirror many properties of physical money, including its ability to work alongside existing account-based systems

Maintenance of the two-tiered banking system: A digital dollar will be distributed through the existing two-tiered architecture of commercial banks and regulated intermediaries

Privacy: The digital dollar will support a balance between individual privacy rights and necessary compliance and regulatory processes, decided upon by policymakers and ultimately reflecting the jurisprudence around the Fourth Amendment

Monetary policy neutral: A digital dollar will not impact the Federal Reserve's ability to affect monetary policy and control inflation. A digital dollar could act as a new policy tool

Technology decisions and design choices driven by functional needs: The policy and economic requirements of a digital dollar will inform both the underlying technology and ultimate design choices

Future proofing the architecture through flexibility: The chosen technological architecture will offer the flexibility to adapt configurability based on policy and economic considerations

Continued private sector innovation: A digital dollar will act as a catalyst for innovation and will not be antithetical to the development of private sector initiatives

DIGITAL DOLLAR FOR CRISIS RELIEF

As this paper is being published, the United States, along with the rest of the world, has been struck with and partially immobilized by the COVID-19 pandemic. As Washington, DC has formulated its emergency relief policy response in the face of the current crisis, it has set upon issuance of direct payments to individuals to offset lost wage income. This initiative has revealed persistent deficiencies and shortcomings in the effective distribution of monies, as an estimated 70 million Americans will need to wait a month or more to receive their direct payments via paper check as the legacy infrastructure systems do not provide a more direct means of payment.[a] We see yet another example with the sudden need for retired COBOL programmers to support legacy computer systems underpinning state unemployment benefit programs.[b]

The pandemic-induced crisis should be a call to action to renovate these long-neglected yet critical payment and financial infrastructure that are becoming increasingly outdated.[c] A CBDC could dovetail nicely with other projects seeking to replace legacy technology infrastructures, such as cloud computing, digital identity,[d] and automation. Some proposals have been made for "digital dollar" electronic cash payment infrastructures to distribute electronic payments directly to consumers. These proposals to date appear to consider "digital dollars" in terms of benefits distribution functionality through accounts-based systems and not as a form of tokenized CBDC.

[a]Klein, "70 million people."

[b]The resultant spike in demand for state unemployment systems has exposed the enormous nationwide risk of technical debt to a legacy computer programming language called COBOL. The call has gone out across the country for retired COBOL programmers to help out of pure necessity: Lee, "Wanted urgently".

[c]Gorfine/Kumar, "Opinion."

[d]A trusted digital identity will be a critical component of an end-to-end solution for effective benefit distribution; however, digital identity is not the focus of this paper and as such is not expounded upon.

CBDC explanation

Introduction to CBDC

The Digital Dollar Project seeks to encourage the next major innovation in the US currency: a tokenized digital dollar that has the same legal status as physical bank notes. This US CBDC issued by the Federal Reserve System would enjoy the full faith and credit of the US government, represent a third format of central bank money, and be fully fungible with Federal Reserve notes (bank notes or cash) and reserves.

The fundamental benefit of this concept is that there is no better, riskless settlement medium than US central bank money.

Across retail, wholesale, and international payments, a tokenized digital dollar would provide a new payments infrastructure that complements and sits alongside existing infrastructures, offering optionality, reduced risk, increased efficiency, and if desired broader access to central bank money.

This development would be a logical step forward given the increased digitization of human and economy activity.

In the two-tiered banking system within the United States, the Federal Reserve issues bank notes for the general public and reserves for the banking system. Our proposed digital dollar would maintain the two-tiered distribution architecture: commercial banks (and potentially other regulated intermediaries with access to the Fed) would exchange reserves for digital dollars to be distributed to end users much in the way they currently do when issuing physical cash to customers through ATMs.

We further believe that a US CBDC would serve to upgrade the infrastructure of money (the ultimate public good) and act as a catalyst for private sector and market innovation. We accordingly do not view a digital dollar as antithetical to the development of private sector payments and stable coin[2] initiatives, many of which seek to tokenize commercial bank money.[3] Similar to today, private sector innovation will build on and around the public infrastructure underpinning the US dollar.

INTEROPERABILITY

Interoperability in the context of this paper means that the digital dollar can function and coexist with current and future financial infrastructure systems both domestically and abroad.

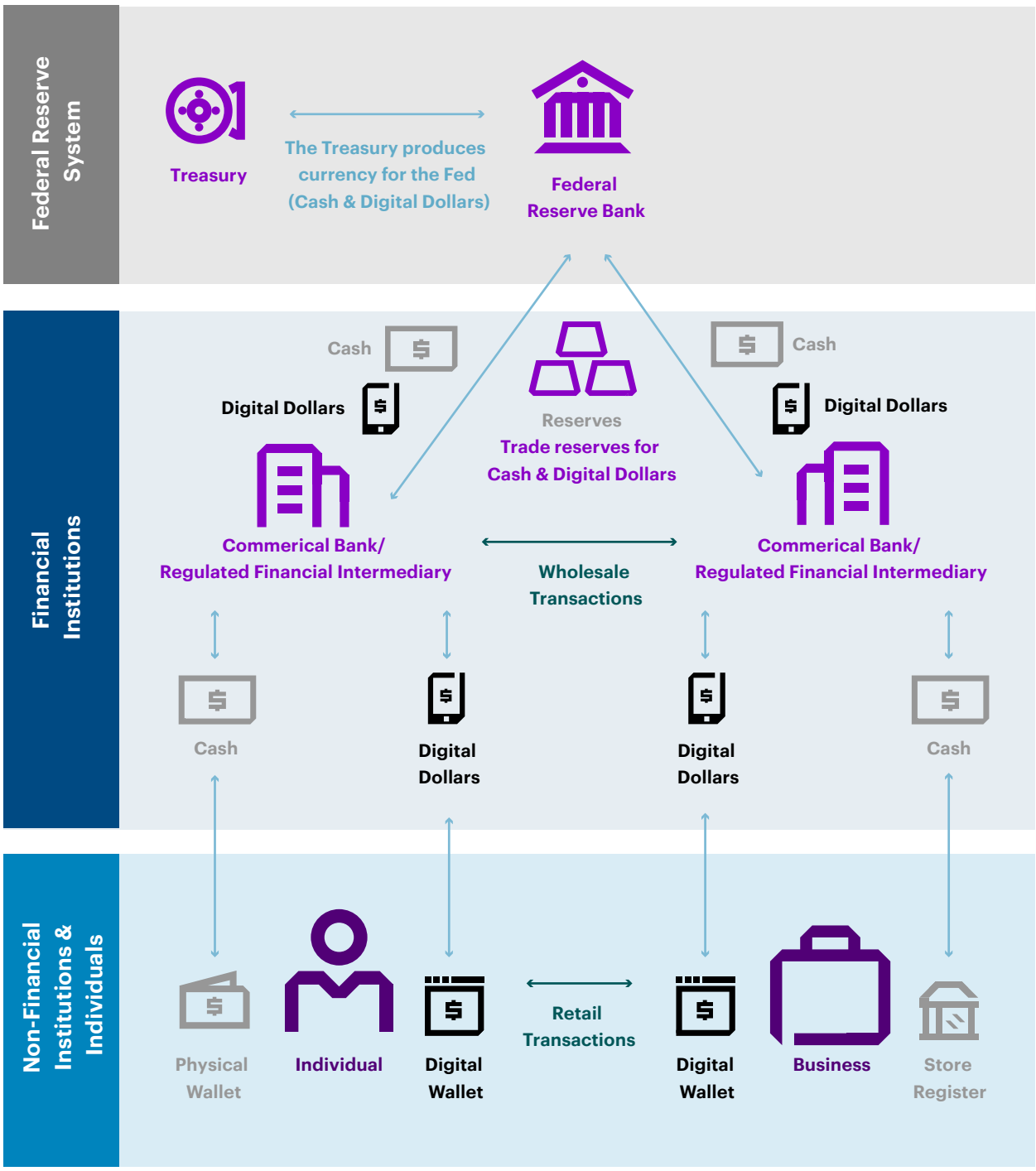
The Project will continue to engage with ongoing CBDC research studies[a] and pilots around the world and encourage the collective effort to achieve the financial infrastructure of the future.

[a]The Project supports collaborative approaches, including the sharing of learnings and best practices, with trusted institutions, such as the Bank for International Settlement (BIS), International Monetary Fund (IMF), Bank of England, Sweden's Riksbank, and others.

[2]A stable coin typically has two components: the token itself and then the value to which that token is pegged. A CBDC addresses the latter component with its value represented as a liability of the Fed. However, a CBDC does not inherently include the business logic built into stable coins.

[3]A key distinction between CBDC and tokenized bank money is that the former is a liability of the Fed and the latter is a liability of the issuing commercial bank.

Two-tier Distribution Model of Physical Cash and Tokenized Digital Dollars



This diagram reflects the current US, two-tier distribution model of physical cash and hypothesized tokenized digital dollars to sit alongside it.

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Enablement: tokenization

"Tokenization" is an essential term to define in order to understand why it is core to our proposed approach. Tokenization is the act of turning an asset, good, right, or currency into a representation with properties that suffice to attest to and transfer ownership. As an analogy to our current world, cash is a physical token. To verify the transaction, you only need to verify the authenticity of the bill (the token), and because each bill is unique, it is impossible to spend the same bill more than once at the same time. As a bearer instrument, a dollar bill cannot be physically held by two people simultaneously (i.e., when it leaves one person's hands, it is now in the counterparty's possession). This differs from account-based electronic money, which uses a reconciliation-intensive, message-based approach to adjust entries in a ledger.

> **Tokenization can provide a new level of portability, efficiency, programmability, and accessibility, ensuring the tokenized digital dollar's ability to complement existing formats of money while simultaneously modernizing our payment and financial infrastructure.**

While electronic transfers of cash have been evolving for several decades, US central bank money as legal currency has seen few, if any, innovations since the proliferation of bank notes during the nineteenth century. Its circulation has remained strictly local and its functionalities limited. The Digital Dollar Project's vision is a tokenized digital dollar that would serve as a new and more dynamic format of central bank money.

The value case for a tokenized digital dollar

The introduction of a tokenized digital dollar would be a driver of innovation for the broader financial system in a fundamental way. A tokenized digital dollar as a new financial medium, combined with new transactional infrastructure such as distributed ledger technology, would provide a new payment rail upon which central bank money can be sent and received. To meaningfully expand upon existing capabilities, it should be portable, sent like a text, thereby allowing settlement irrespective of space and time.

A tokenized digital dollar could play a crucial function in serving as the safest form of money and therefore offers value above and beyond existing currency mediums. Programmability is another feature that could unlock additional avenues for innovation and precision in value transfers. A tokenized digital dollar could enhance confidence, efficiency, and functionality in dollar payments across retail, wholesale, and international payment use cases:

Retail Payments: Among the multitude of highly effective payment options in the US (e.g., cash payment, credit, debit, etc.), a digital dollar would offer a new choice for digital transactions, instantaneous peer-to-peer payments, and in-person transactions. It could also potentially lower costs and further diversify payment rails. A digital dollar could be distributed to the end user through commercial banks and trusted payment intermediaries while facilitating financial inclusion by broadening access to services via additional mechanisms, such as digital wallets. In particular, a digital dollar could expand the ability of currently un-or-underbanked populations to access digital financial services and transact on ecommerce platforms that do not deal in physical cash.[4] Bank notes are often used to make small payments in the physical world, although, on average, physical cash usage is in decline compared against other payment methods.[5] This dynamic is likely to progress in a post-COVID 19 world, thereby making it increasingly important for digital financial options to extend more broadly.

[4]Within the existing framework of online commerce (i.e., when payment is required at time of purchase with a delayed delivery), transacting in a digital dollar may raise new challenges. Today's payments made via card networks establish a consistent set of terms for recourse if a consumer is not satisfied with their purchase. A potential solution to consider would be the inclusion of such consumer protection frameworks around online payments from private sector wallet issuers.

[5]Kumar and O'Brien, "2019 Findings."

Wholesale Payments: Today, wholesale payments rest on national payment systems, and they are typically conducted through interbank clearing using central bank money to settle securities and other large value payments in real time gross settlement (RTGS) systems like Fedwire. Current wholesale large value transactions are account-based and predominantly executed by banking and payment providers who have accounts with the Federal Reserve. Due to the nature of the prevailing account-based system, only organizations with accounts can transact in central bank money. Just like a physical dollar, a tokenized digital dollar would provide alternative access to central bank money outside of accounts. Accordingly, it could facilitate broader, more diverse access for institutions to large value payments and support the emergence of digital financial market infrastructures. Furthermore, from a settlement perspective, a tokenized digital dollar could provide atomic delivery, either Delivery versus Payment (DvP) or Payment versus Payment (PvP).[6] These potential approaches could serve as a way to reduce fraud and counterparty risk, although the decision for settlement time duration will be a business and/or policy design choice to determine the optimal settlement window for transactions.

International Payments: International payments currently cannot be conducted digitally in US central bank money. A digital dollar could allow more direct monetary relations to be established, reduce risks, address time delays caused by today's correspondent banking model, enhance competition in international payments, and advance financial market integration.[7] The use of a digital dollar in cross-border and offshore transactions would allow digital payments in central bank money to be made for remittances and large value payments, including the possibility to conduct offshore securities settlement.

[6]Atomic DvP or PvP occur when both legs of a transaction (payment or asset) are exchanged simultaneously. While atomic delivery can also occur with a tokenized US CBDC in retail and international payments as well, it has been highlighted primarily as a benefit for wholesale payments due to the large transaction size typically associated with these transactions.

[7]A digital dollar could make remittances sent in US dollars cheaper and more efficient, but these end-to-end benefits would be muted for remittances where a US CBDC is exchanged for a non-tokenized foreign currency.

ACCESS AND INCLUSION

One area of promise with respect to a US digital dollar is in expanding financial access and inclusion for unbanked populations. A 2017 FDIC survey[a] found that roughly 14 million American adults lack a bank account—a figure that became all the more important during the COVID-19 pandemic when the US government struggled to distribute emergency relief funds to many of these individuals. The Project believes that lower system costs and digital wallets tied to the custody of tokenized digital dollars may hold advantages over traditional bank accounts in terms of expanding access to underserved populations.

Given the limited but critical functional scope of a digital wallet in focusing on custody, it is possible that the costs associated with providing individuals with wallet services might be lower than the costs of hosting a traditional bank account, particularly given the range of programs and government benefits that can be distributed utilizing wallet services. This would also allow private sector providers to expand coverage of such services to un-or-underbanked population that have access to mobile devices.

In order for this to be true, however, the digital wallet will need to prove to be less expensive to offer from a technology, regulatory, and administrative perspective. This hypothesis can be tested in real-world pilot scenarios. In situations where private sector solutions are not viable, policy solutions could be developed around public wallet government programs or services that fill remaining gaps in coverage.

Assuming the technological efficiency and potentially reduced regulatory costs associated with offering a digital wallet, one can imagine smart phones and devices preloaded with such a solution, or a minimum, the application programming interfaces (APIs) to allow for mobile applications to function. The wallet could be readily registered through a regulated hosting intermediary[b] performing requisite Know Your Customer/Anti-Money Laundering (KYC/AML) checks. Had this been the case during the COVID-19 crisis, many of the currently underbanked may have had an alternative means of receiving funding other than by physical check.

[a]Prang and Kayashi, "US 'Unbanked'".
[b]Of course, this discussion contemplates hosted digital wallets, which would require a regulated intermediary providing the service. There are a range of non-hosted wallets that could also conceivably custody a tokenized digital dollar. These solutions would not be managed by a regulated intermediary, however. The decision to permit un-hosted wallets is a separate policy and design choice subject to separate analysis and consideration.

Taxonomy

Payments are transfers of monetary value from payers to payees that come in many forms, usually in exchange for goods and services or to fulfill contractual obligations. For this paper, we will classify all payments made between financial institutions as "wholesale" and all payments made between non-financial entities, even if financial institutions are intermediaries in those transactions, as "retail." This classification means that the specific payment channel or value does not determine whether a payment is retail or wholesale.

Nonetheless, wholesale payments are typically high-priority, large-value transfers. Wholesale payments are usually settled via dedicated interbank settlement systems. In contrast, retail payments are usually lower-value transactions between individuals, businesses, and governments in forms such as cash, checks, credit transfers, and debit and credit card transactions.[8]

[8]Bech, Shimizu, and Wong, "The quest for speed,".

Within the United States, there are six primary payment mechanisms (other than cash):

Category	Name	Ownership Structure	Geography	Participants	Accessibility	Differentiator
Wholesale payment systems	Fedwire[9]	Public; owned by the Federal Reserve	Domestic	10,000 financial institutions[10]	Limited	Real-time gross settlement system (RTGS) that allows participants to send and receive final payments in central bank money
	Clearing House Interbank Payments System (CHIPS)[11]	Private	Domestic and international	50 financial institutions	Extremely limited	A US network that batches and nets payments before processing; may rely on Fedwire for settlement
	National Settlement Service (NSS)[12]	Public; owned by the Federal Reserve Banks	Domestic	1,097 active settlers (e.g., clearing houses, financial exchanges, and other clearing and settlement groups)	Partially limited	Settlement service offered for participants that sums and settles transactions across multiple parties rather than settling transactions individually; may rely on Fedwire for settlement
Retail payment systems	Check clearing systems[13]	Public and private	Domestic and international	Consumers, businesses, and federal, state, and local governments	Widely accessible	Systems involving either accounting entry settlement or interbank settlement[14]
	Automated Clearing House (ACH)[15]	Public (Federal Reserve) or private (Clearing House's Electronic Payments Network, EPN)	Domestic and international	Consumers, businesses, and federal, state, and local governments	Widely accessible	Nationwide electronic file transfer mechanism that processes both credit and debit transfers initiated by depository institutions and can be eventually settled on the financial institutions' Federal reserve account
	Payment card networks[16]	Private	Domestic and international	Consumers, businesses, and federal, state, and local governments	Widely accessible	Credit card and debit card networks that sort and route transaction data from acquiring to issuing banks over proprietary networks

[9]FRBservices.org, "Fedwire®."
[10]"Financial institutions" when used here means any institution that maintains an account at a Federal Reserve Bank and includes Federal Reserve member banks, non-member depository institutions, and certain other institutions, such as US branches and agencies of foreign banks. The US Treasury and other federal agencies, as fiscal principals, can participate in Fedwire.
[11]The Clearing House®, "About Chips."
[12]FRBservices.org, "National Settlement Service."
[13]CPSS – Red Book, "Payment, clearing."
[14]Paper-based checks are primarily scanned ("truncated") and processed electronically. Ibid
[15]Ibid
[16]Ibid

These payment processing systems work in conjunction with each other (e.g., across both retail and wholesale payments), combining the benefits of individual systems.[17]

CBDC, as a new format of the existing currency, is distinct from existing payment methods and allows for the creation of new payment channels that would help support an innovative and more resilient payments landscape. CBDC could exist alongside Fedwire and complement (not impede) in-flight initiatives like FedNow.[18] Despite a slight overlap with existing and proposed payment initiatives, a US CBDC unlocks new benefits due to its new payment architecture.

As mentioned above, all the existing payment mechanisms work on an account-based model. Our model of the digital dollar is distinguished by its nature as a token, allowing cash-like properties to complement benefits of the existing account-based payment mechanisms. A breakdown of token-based versus account-based models is discussed on the following page.

[17] Below are examples of payment systems that are utilized for both "retail" and "wholesale" payments (Ibid):

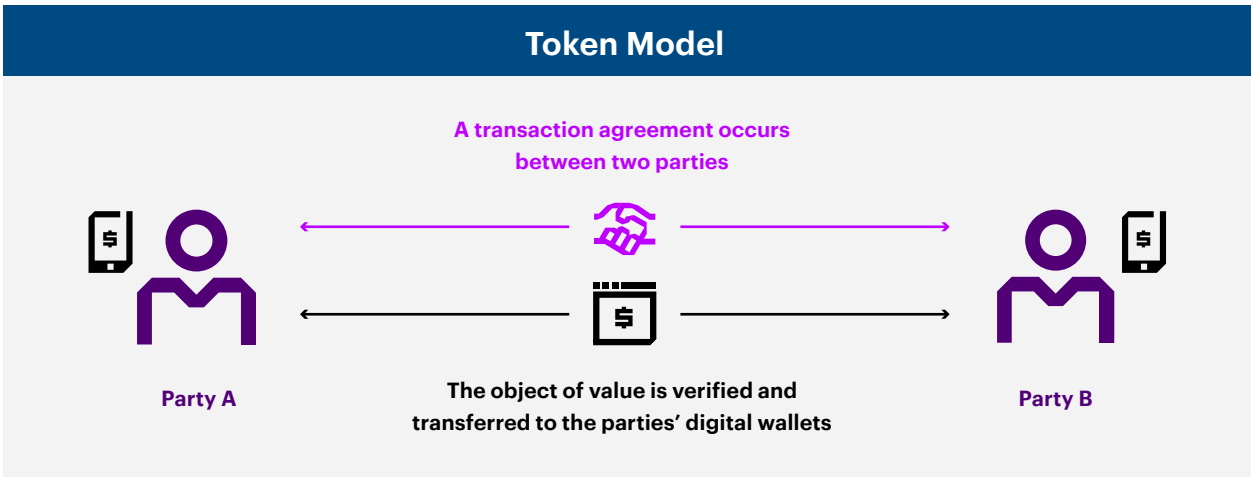
- ACH + Fedwire settlement example: Individuals use ACH to send payments to businesses or other individuals throughout the day. These transactions would be considered retail transactions because they are between non-financial entities. Those ACH payments are intermediated by financial institutions, and on a periodic basis, netted and settled between each other using Fedwire. The settlement transaction between the financial institutions would be wholesale.
- FedNow example: A real-time gross settlement (RTGS) system focuses on providing real-time settlement for low-value, high-volume transactions, targeted specifically to address individual-to-individual and individual-to-business transactions. Even though all FedNow transactions are settled in real-time between financial institutions in their reserve accounts, those financial institutions are only acting as intermediaries for their customers. FedNow transactions settle immediately, as opposed to ACH, which is why ACH requires a separate settlement transaction.

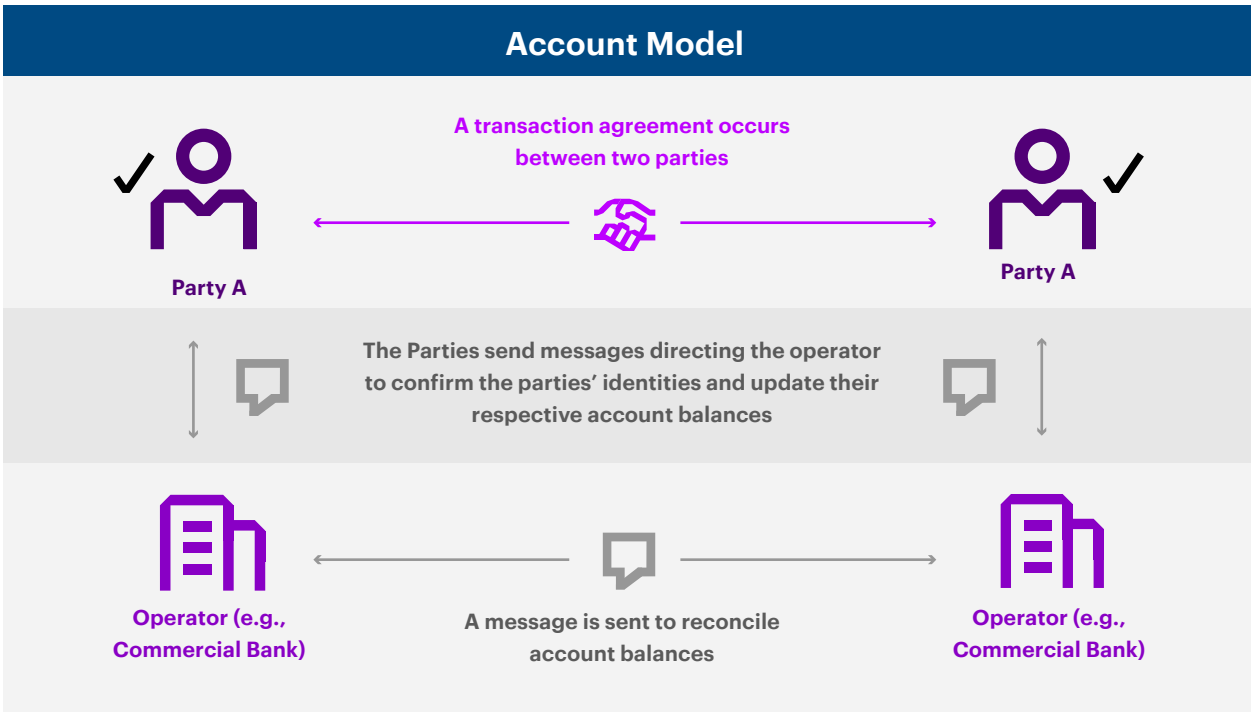
[18] The Federal Reserve Banks are developing a new interbank 24/7/365 RTGS service with integrated clearing functionality called the FedNow Service. When available, the service will help enable financial institutions to deliver end-to-end faster payment services to their customers. FedNow is expected to be available in 2023 or 2024. (The Federal Reserve. "FedNowSM Service."; The Federal Reserve, "Federal Reserve Announces.")

Benefits of tokenization

When we talk about a digital dollar, we are referring to a token-based digital representation of money issued by a central bank that is a digital bearer instrument, akin to a digital bank note representing a direct liability of the Federal Reserve. Other literature on the topic of CBDC makes a distinction between token-based and account-based. The method of exchange verification primarily differentiates the two vehicles.[19]

In a token-based system, the token contains all information necessary for the recipient to verify the legitimacy of the transaction, and the recipient can verify the object transferred (i.e., the token).





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[19]For a recent example, see: Bank of England Discussion Paper, "Central Bank."

In an account-based system, the operator of the system authenticates the sender to ensure authorization to update account balances on a potentially centralized account ledger.[20] Physical cash (i.e., bank notes) is an example of token-based central bank money, and central bank reserve accounts is an example of central bank account-based money. Negotiable instruments (e.g., promissory notes) and bearer bonds are also usually token-based.

Token-based systems rely on the object transferred. They allow various degrees of decentralization since transactions can occur upon the bilateral transfer of the token rather than relying on a potentially centralized account ledger.

Because the object is the value, validation channels to limit counterfeit tokens and duplicate tokens must be included to provide integrity in the system. The onus lies on the intended recipient to verify the integrity of the token and that its value is transferrable in a subsequent transaction. For example, when physical bank notes, a token-based form of money, are used in a transaction between a consumer and a retailer, the retailer may use methods, such as examining the paper and looking at the security ribbon and holograms, to ensure the authenticity of the bank note because the merchant's bank will not accept a counterfeit bill in a deposit.[21]

In a token-based model, distributed ledger technology (DLT)-based or -inspired systems ensure uniqueness and prevent duplicate spends. That is, data is available that indicates where control of tokens should be at any given time, so that recipients can automatically check tokens' future transferability. DLTs function by implementing synchronization rules whereby multiple machines storing copies of the ledger achieve "consensus" on transaction ordering. Key to this model is its ability to automate—and thereby enhance the efficiency of—transactions. The consensus model could fall along a spectrum from centralization under the control of one entity to high decentralization depending on the desired features of the system. The synchronization or consensus rules provide a mechanism to design and control specific transaction features, depending on the desired control of the network operators.

[20]Decentralized or distributed account-based systems exist without a centralized "operator" or centralized ledger. The key feature making even these decentralized systems account-based is that transactions require updating a balance, as opposed to providing an object (token) that can be further transmitted without verifying a balance on the ledger.
[21]For a list of security features and to learn how to authenticate a $100 bill, see: US Currency Education Program, "$100."

Account-based systems rely on authentication to authorize an instruction to update balances on a ledger. That authorization could be anything from an approval after logging into a bank's mobile application, a pseudo-anonymous account number and secret password, a non-third-party paper check, a SWIFT message, or any other method to provide an authenticated message. Most account-based systems rely on a trusted third-party operator to maintain a single ledger, as is the case with Federal Reserve accounts and depository accounts.

Account-based systems exist in part because of the limitations of physical tokens in that physical tokens like bank notes can be difficult to transmit, store, handle, and use anywhere other than face-to-face transactions. The six primary payment mechanisms in the United States described above, all account-based, have dominated the payment landscape because they make the transmission of money extremely efficient and solve many of the challenges of physical tokens for many use cases.

However, physical cash continues to be used because token-based mechanisms have benefits with which account-based mechanisms cannot compete, including a degree of decentralization, privacy, resiliency, and safety[22] that a bearer-like object uniquely provides.

The inherent portability of a tokenized US digital dollar allows for the token (i.e., a bank note in digital format) to be exchanged in near real-time, regardless of physical location. This new feature allows a tokenized digital dollar to complement existing currency mediums such as bank notes and accounts. We believe that tokenization provides unparalleled opportunities for innovation in the areas of payment and financial infrastructure.

[22]Similar to other bearer instruments, there is risk of loss if the user decides to self-custody. There are potential architectures of a CBDC system in which end users access their CBDC through a hosted wallet, which could limit risk of loss.

Privacy

Privacy is a deeply personal concept; individuals have their own barometer of what they consider private, including when and with whom their personal information can be shared. Recognition of an individual's right to protect privacy, particularly from the federal government, was a central tenet of the development of the US constitutional form of government and is most prominent in the Fourth Amendment to the Constitution.

Options for addressing privacy considerations can be viewed on a theoretical scale. On one end, there could be a completely anonymous, untraceable system. Despite its appeal, such a system would facilitate illegal and illicit behavior. Not only would this be undesirable from the perspective of law enforcement, it would also gradually undermine the very value of the currency itself. Conversely, a system designed for full surveillance and traceability may achieve broad goals of law enforcement and national security. However, that transparency would reduce its attractiveness and inhibit adoption by even the most law-abiding users and thus lessen demand for, and by proxy the value of, the currency at home and abroad.

Accordingly, practical consideration should be given as to where to draw the line in developing a digital dollar so that individual privacy rights are respected but necessary compliance and regulatory processes (e.g., AML/KYC) are properly enabled.[23] Technology solutions that might permit simultaneous pursuit of proper regulatory and privacy interests should also be explored.

One approach in balancing privacy and law enforcement surveillance could involve a system that follows the current treatment of cash. However, it is important to remember while physical monies were not designed to protect the privacy of transactions or its user—it was simply an inherent feature of an analog bearer instrument—the US government and financial regulators have provided guard rails around cash in an attempt to limit illicit behavior. Such regulations include the filing of IRS form 8300 to report cash payments over $10,000 received in a trade or business.

HYPOTHETICAL TRANSACTION LIMITATIONS

Thoughtful macro, micro, and behavioral economic analyses should be undertaken to find the equilibrium threshold that maximizes consumer activity and minimizes illicit activities. For physical cash, policymakers have determined that the threshold is at $10,000. As development of a digital dollar progresses, policymakers will need to determine parameters, such as timeframe, participants, and/or amount, that maintain individual liberty and minimize illicit behavior given the newfound ease of use of a digital dollar.

[23]European System of Central Banks (ESCB) tested a proof-of-concept (PoC) for retail CBDC in which they demonstrated the feasibility of constructing a simplified CBDC payment system that allowed users some degree of privacy for lower-value transactions while ensuring that higher-value transactions were subject to mandatory Anti-Money Laundering/Combating the Finance of Terrorism (AML/CFT), the European equivalent of AML/KYC, checks. (IN FOCUS, "Exploring.")

The degree of privacy available in a digital dollar will ultimately reflect the development of jurisprudence around the Fourth Amendment. When personal information is taken by the federal government directly from a person, the Fourth Amendment clearly requires that seizures and searches of their "papers and effects" must not be "unreasonable." The general legal exception to the Fourth Amendment, known as the "third-party doctrine," is that information knowingly shared with a third-party is not subject to constitutional protection and is therefore subject to seizure and search according to lower statutory standards. Yet, the third-party doctrine predates the digital era. It now arguably conflicts with the US Supreme Court's often-stated goal of preserving the degree of privacy against government that existed when the Fourth Amendment was adopted, and the Court has recently declined to extend the third-party doctrine to cellular communications data.

Fourth Amendment protections against government infringement of individual financial privacy are not insignificant compared to other democracies and non-democracies. The digital dollar should be designed to support the full array of information policies that exist now and that may exist in the future, from information-free cash transactions to payments that are recorded, reported, or limited for tax, law enforcement, and national security purposes. With the proper legal and jurisprudential development, the digital dollar may well enjoy superior constitutional privacy rights over many competing digital currencies. Transparency in the design and implementation of policy-based limits and requirements would help ensure that the tension among values is resolved consistently with democratic and rule-of-law norms.

Configurable design choices and options

One of the exciting innovations of a tokenized CBDC is the concept of "programmable" money. This concept means that, as part of the design and build phases, the technology can be configured, and potentially reconfigured, to enable critical functional requirements and achieve desired benefits. More specifically, tokenization can allow for individual programmability per token and transaction rather than uniform programming across an entire ledger or infrastructure.

The Project recognizes that policies and implementation surrounding a tokenized US CBDC will be made by US policymakers, but we seek below to offer our insight and guidance to the public discourse and provide thoughtful recommendations where possible. With that in mind, key configurable functionalities of a tokenized digital dollar provide innovative currency benefits such as controlled anonymity, interest-bearing capabilities, account limits, and broader accessibility.

We believe it is essential that a US CBDC maintains and supports the current two-tier banking system as the overarching architecture. A two-tiered banking system preserves the current distribution architecture and its related economic and legal advantages, while inviting innovation and accessibility.

Similar to how commercial banks distribute cash on behalf of the Fed, the Fed would issue digital dollars to regulated intermediaries in exchange for reserves, and the intermediaries would distribute digital dollars to their customers on demand. A user would have the ability and choice to hold their digital dollar in their digital wallets, or deposit it into a bank account, which the bank would be able to lend against. Unless the digital dollar is put into a safe deposit-like storage or custodial solution, once exchanged for balances in a bank account, it is fungible with other monies as it is on a banks' balance sheet. This is important for several reasons, but one of the most vital is to ensure that consumers and businesses keep deposits at commercial banks. These deposits underpin the entire US economy by enabling banks to lend funds to borrowers for activities such as buying a home, building a new factory, and everything in between.

CYBERSECURITY

Cybersecurity will be a central requirement of a digital dollar. There are many solutions addressing cybersecurity such that risk can be mitigated. Our current financial infrastructure exists on legacy systems and has significant modernization needs; as a result, it is vulnerable to exploitation. By launching a tokenized US CBDC, a new infrastructure could be built leveraging the latest cybersecurity technology. The highest standards to which cybersecurity can be advanced will be necessary in the creation of a digital dollar.

Recognizing that a US CBDC involves both change and innovation, we are cognizant of persistent themes regardless of use case. As noted above, there are myriad design configurations, but below are a few points highlighted for further discussion as they will be critical elements of a successful digital dollar.

National Security: The US, especially after September 11, 2001, has invested considerable resources to maintain the national security of the US. A tokenized CBDC should be configured to provide effective infrastructure to support transactional security standards such as KYC, AML, Anti-Terrorist Financing (ATF), and anti-fraud as well as anti-counterfeiting measures. The Project intends to convene stakeholder working groups to develop these design features and recommendations.

Interest-Bearing: A US CBDC could be configured with the functionality for the token itself to be interest-bearing or not. If chosen not to include that functionality, the system would work in the same manner that cash does today in that it does not bear interest when held outside of an account but can bear interest upon deposit. In today's world, consumers can choose to maintain their money in either a safe deposit box or in the safety of their own homes with the understanding that they will not earn interest or receive Federal Deposit Insurance Corporation (FDIC) insurance protection. If and when money is placed into commercial bank accounts, the money becomes fungible for the bank to use and lend in return for bearing interest to the depositor. If it is decided that the CBDC would include interest-bearing functionality, the ability to apply a positive or negative interest rate could enhance opportunities for the implementation and transmission of monetary policy. The risk is that, as an interest-bearing instrument, CBDC would resemble more of a bank account and could complicate the impact of a CBDC on banks. The substitutability between bank accounts and CBDC remains a decisive element for the intermediation role of the banking system.[24]

Transaction Security: Transaction security across multiple dimensions like KYC, AML, counterfeit, and fraud must be considered. The maintenance of the US two-tiered banking system allows existing financial institutions to maintain and deploy their KYC/AML policies when it comes to distribution as well as the use of a US CBDC. Furthermore, a US CBDC could inherently encompass qualities such as instantaneous verification to reduce counterfeit efforts and potential fraud.

Validation and Governance: A digital dollar would be enabled by new payment infrastructures inspired by distributed ledger and decentralized technologies. Our champion model intends to explore DLT, with public, private, and perhaps novel public-private organizations validating transactions. Through careful deliberation, the Project will develop a framework for the validation and governance of the new network. The Project's approach is inspired by the creation of the internet, which was developed through a model of public-private partnership.

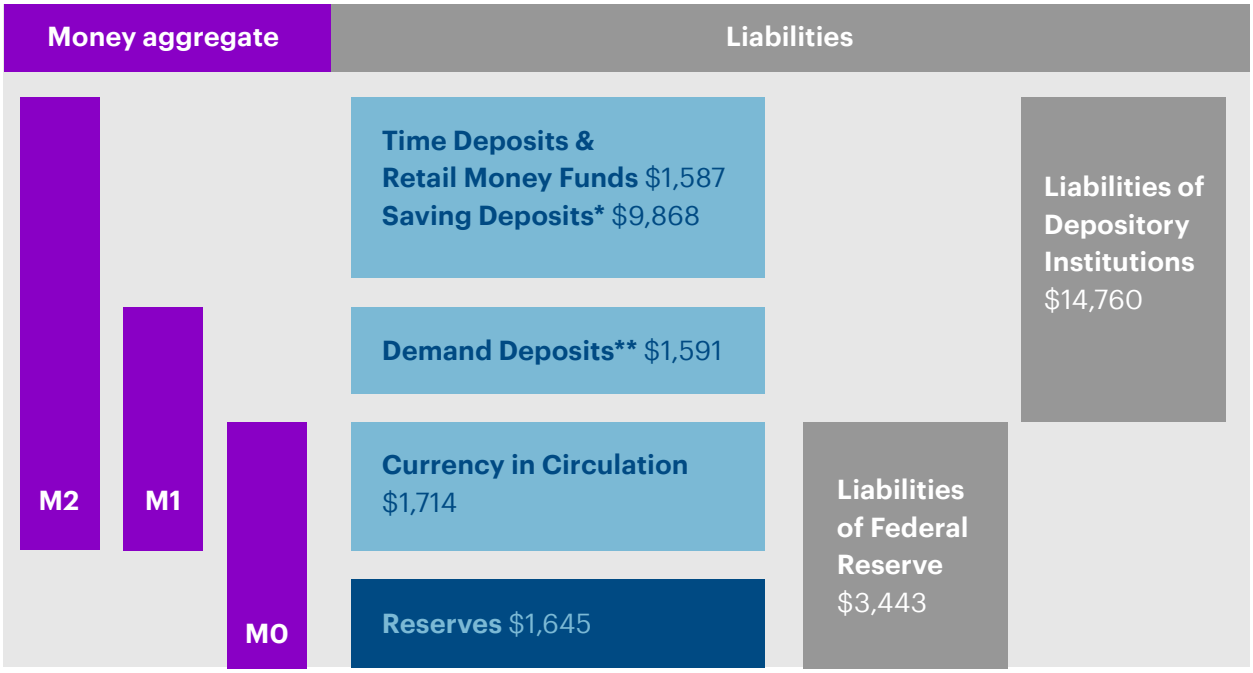
[24]As we experience the effects of today's near-zero interest rate environment, it is worth discussing the theoretical possibility of negative interest rates and the effects of a tokenized US CBDC. In a zero or negative interest rate environment, the opportunity cost of holding cash is low and perhaps attractive given the inability to earn interest. As long as physical cash continues to exist alongside a tokenized digital dollar, per our recommendation, the subsequent broadening of the monetary transmission tunnel and the potential effect of near-zero to negative interest rates would be muted.

Benefits of a CBDC in the context of a US dollar

Throughout history, currency has undergone functional advancements to improve its usability as a result of new demands and changing economies. As we enter the third decade of the twenty-first century, a CBDC is the next logical step in the evolution of currency to support the demands of an increasingly digital economy. The creation of a digital dollar provides an infrastructure that could facilitate global trade, catalyze private sector innovation, unlock new markets, and equip our financial system for the digital world. It provides new functionalities and utilities beyond those of today's central bank reserves and paper money, including portability and programmability. It could offer broader access to US dollars, reduced operational complexities, improved cost efficiencies, greater market transparency, reduced counterparty risk, and increased trade liquidity. The features of cash in a digital format would enable commerce to happen at a greater velocity and allow money to flow more efficiently through the domestic and global economies.

When discussing the US dollar, there are some unique factors to consider. Contrary to conventional wisdom, the dollar is not the money of the US, but US money is expressed in dollars. The dollar is normally associated with physical dollar bills, but there are multiple monetary liabilities denominated in dollars. Money is mostly a liability of depositary institutions, but currency is a liability of the Federal Reserve (Figure 1).

Figure 1. US money in billions as of January 31st, 2020[25]



*Excludes small-denomination time deposits. **Includes other checkable deposits at commercial banks and thrifts institutions including NOW and ATS balances.

Illustrative purposes only

[25]The Federal Reserve, "Aggregate."

The Federal Reserve issues central bank money comprised of currency, in the form of dollar bills, and reserves. Dollar bills are available to the general public and used mostly for retail payments. Federal Reserve notes and US Mint coins are legal tender in the US and obligations of the US Treasury. Reserves can only be held by banks and are used mostly in inter-bank clearing to settle large-value or wholesale payments. Currency and reserves are fully fungible. Most payments are conducted in liabilities of depository institutions or bank money, including through credit cards, money transmissions, and wire transfers.

Central bank money plays a special role, particularly in wholesale payments and foremost in securities trading. In the US, no money is safer than money issued by the Federal Reserve. It mitigates risks and offers settlement finality. Regulators and market participants have a strong preference for using central bank money.

The distribution of currency occurs through the banking system. Banks acquire currency from the Federal Reserve against reserves. Individuals can obtain currency from their banks against debits of the demand deposits. The Federal Reserve buys and sells mostly government securities from banks in exchange for reserves.

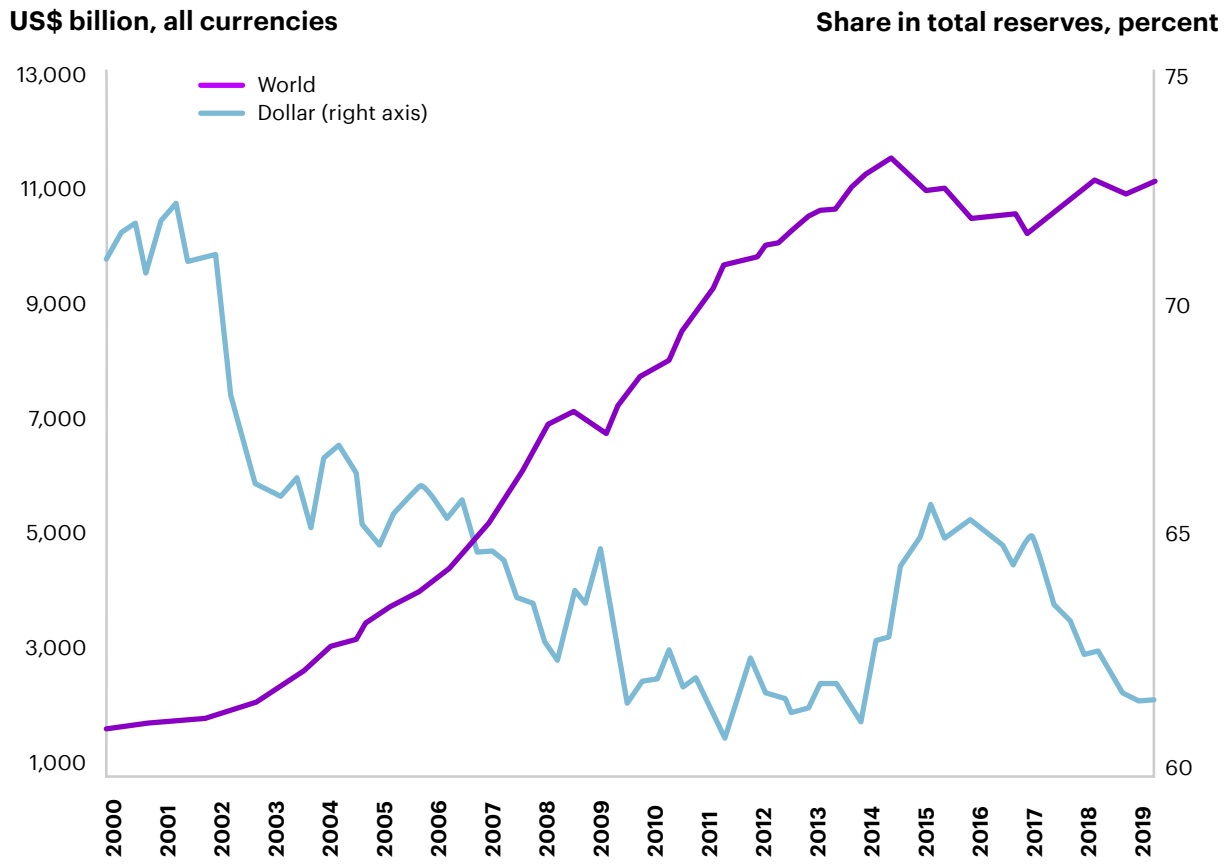
A US CBDC would be a liability of the Federal Reserve denominated in dollars and form an integral part of M0 (Figure 1). It would be distributed like, and act as a complement to, dollar bills and could be used in transactions conducted in currency and reserves.

Understanding the role of the dollar in the global economy

US money is by far the most important money in today's global world. Its role rests on the use of dollars to conduct international transactions based on the availability of financial instruments denominated in dollars and the depth of the US financial markets, including derivatives markets for the hedging of dollar exchange and interest rate exposure. It is also anchored in the relative stability of the dollar against most other currencies, instilling trust and confidence that dollars serve as an effective medium of exchange and store of value.

The use of dollars is revealed in the high share of the dollar in foreign exchange transactions, bank funding, invoicing of exports and imports of goods and services, central bank foreign exchange reserves, and international loans (Figure 2). The widespread use of dollars implies that a large proportion of securities and other liabilities denominated in dollars are held by entities abroad.

Figure 2. Central banks' foreign exchange reserves[26]



Illustrative purposes only

The international use of the dollar has attracted considerable criticism. Some argue that the US incurs undue benefits, often associated with the notion of "exorbitant privilege," as foreigners are obliged to hold liabilities denominated in dollars, providing the US with low funding costs and allowing it to sustain large external deficits.[27] Others argue that the dollar's popularity is a burden, as the US, unlike other countries, cannot use the exchange rate as an effective policy instrument. The universal use of the dollar and a large proportion of foreigner-held liabilities have established considerable interdependencies between the US and other countries.

[26] IMF, "Table 1." The dollar has remained the dominant reserve currency over time despite changing shares of the dollar in foreign exchange reserves. Central banks accumulate reserves in foreign exchange, whose amounts fluctuate. The dollar has stabilized around ~66% of central banks' foreign exchange reserves and therefore has remained the dominant reserve currency despite fluctuations.
[27] The notion of exorbitant privilege can be traced back to remarks made by President Charles de Gaulle in 1965.

The importance of dollars in international transactions makes the Federal Reserve the only central bank that can create international liquidity. The March 2020 augmentation and extension of the Federal Reserve dollar liquidity swap lines with some of the leading central banks reveals the importance of dollars to support orderly international transactions. The lack of dollar liquidity, often shown in an appreciation of the dollar against other currencies, has often been associated with financial crises.

The success of the US dollar rests on a number of key factors that explain why most countries do not have currencies that are readily accepted in international transactions. Most currencies do not have the necessary infrastructure (including deep, liquid financial and hedging markets and technology and operational channels) for currency transacting, clearing, and settlement. Most currencies also do not enjoy comparable economic and governmental stability, rule of law, and trust to be used outside their home countries.

While several countries aim for their currencies to play a greater role internationally to reduce dependence on the dollar, the persistent strength of the dollar indicates the formidable advantages it enjoys.

> **Rather than being a defensive measure, tokenization of the US dollar should be viewed as a proactive opportunity to enhance the technological infrastructure underpinning our currency to future-proof its role in the global economy.**

Improvement in the future utility of the dollar

The increasing digitalization in payments has transformed money, and as a result, money will need to adjust to new payment needs to preserve its utility. The US was a pioneer in payment innovations with the introduction of the credit card (Diners Club), the real-time gross settlement system (Fedwire), and online money transfers (PayPal). The dollar's primacy can be attributed to many factors, several of which stem from the Bretton Woods Agreement of 1944, the resulting network effects, and the absence-to-date of a serious competitor for reserve currency status; however, the dollar's utility is and remains a critical success factor. The US should ensure its money remains competitive, as past performance is not an indicator of future success.

Money has been represented by book entries (i.e., accounts) for centuries. Book entries imply money exists as a liability of the bookkeeper, and parties would need to hold an account with the same bookkeeper to transact in that same money. Coins and the proliferation of modern bank notes have enabled the portability of money to exist in parallel with the book entry (accounts) system.[28] Portable, digital money by the Federal Reserve, however, does not exist.

[28]Smith, "What is Debt?"

The digital portability of money endows it with new functionalities and utility. One of these new innovations may be a consumer wallet infrastructure that enables custody and recoverability[29] of digital dollars, a function unavailable with physical cash. Securities could be settled against central bank money anywhere. Foreign currencies could be exchanged by a simple swap of central bank money. Emergency support could be sent in real-time. Monetary relations would be more direct, and execution, instantaneous.

Like cash, digital dollars will be unique—existing only in a single location—and are the responsibility of the owner. If someone were to lose or destroy the cash in their physical wallet, their banks would not be responsible for replacing the lost cash. Similarly, if a digital dollar is withdrawn from the banking system and exists on an individual's non-hosted digital wallet, and if that digital wallet were to be lost or destroyed, the individual would be the sole responsible party for the loss.[30] There are important implications of this that may influence the decision of the individual to hold their money outside of a regulated custodial wallet or bank account. The flexibility of how a CBDC can be stored, backed up, and maintained are decisions that should be determined through policy, regulatory, and infrastructure discussions.

While monetary innovations are typically developed by private sector actors, central bank money maintains a critical role in providing confidence and reducing settlement risk. This special role of central bank money means that the US cannot delegate all monetary innovation to the private sector. Therefore, the development of a US digital dollar as a public good, upon which private sector innovators can build, will influence its future utility.

How a digital dollar supports a key Federal Reserve System objective

The Federal Reserve pursues the longstanding public policy objective of promoting the safety and efficiency of the payment system and ensuring an equitable provision of payment services to financial markets.[31] The effective distribution of Federal Reserve money is essential to support the orderly functioning of financial markets and payments. It will depend on distribution, transparency, efficiency, resilience, and innovation in payments.

The portability of a digital dollar would enhance reach and effectiveness and complement existing operations of the Federal Reserve. A digital dollar would facilitate the distribution of central bank money abroad. While the Federal Reserve dollar swap lines only reach foreign central banks and do not afford foreign financial institutions settlement in central bank money, the Federal Reserve could allow digital dollars to be sent abroad through the domestic banking system directly to foreign institutions in need.

[29]This functionality would likely be a private sector innovation and not a function of a US digital dollar, as a CBDC should be thought of as a bearer instrument. Private sector companies must carefully evaluate the benefits of this option, as it may introduce moral hazard risk and increased incentive to hold large sums of CBDC outside of the banking system.
[30]As stated previously, there is risk of loss if the user decides to self-custody their CBDC. There are potential system architectures in which end users access their CBDC through a hosted wallet, which could limit risk of loss.
[31]*The Federal Reserve System Purposes & Functions*, "Fostering Payment."

Digital dollars could be used to conduct settlement of US government securities in central bank money to afford the same confidence and quality of settlement as trading domestically. It could reduce funding stresses abroad and shield the domestic market from adverse foreign shocks.

The digital dollar would also enhance payment transparency, thereby supporting the Fed's objective to promote safe and efficient payments. Depending on design choices, digital transactions could offer degrees of traceability, and aggregate payment data could be analyzed in real-time to provide key insights into economic health and activity. This enhanced transparency and real-time analytics would, of course, need to be considered and implemented within the proper legal frameworks.

The digital dollar would promote diversification of the payment system, thereby increasing the safety and efficiency of our payment infrastructure. It would live on alternative payment rails, enhancing the resilience of the payment infrastructure. It may also attract new actors offering services related to the digital dollar, spurring financial innovation and fostering financial integration.

The dollar remaining as the world's premier reserve currency

In the analog world, during the turn of the twenty-first century, the unit of account for most of the world's tradable commodities, financial benchmarks, and important contracts was the US dollar. As we approach the middle of the century, new technology has emerged that enables digitization and tokenization of things of value. Across the globe, governments and private institutions are experimenting with tokenized commodities, contracts, legal titles and, most critically, commercial and central bank digital currencies that can be coupled with algorithmically-driven smart contracts. Although nascent, this digital innovation continues to expand globally.

Imagine, for example, a large African city with a critically important water filtration station, in which a computerized sensor recognizes that its reserves of chlorine are running low. Thanks to 5G telecommunications technology, it would not be long before that sensor instructs a computer to order chlorine from an overseas supplier automatically, direct a CBDC payment to that supplier, and accept a drone delivery of the supplies all with little-to-no human management.

Undoubtedly, such a system, rooted in a digital infrastructure and tokenized currencies, would create direct information and money transfer mechanisms that avoid transaction intermediaries, which would bring efficiency gains to smart cities, supply chains, and electricity grids. It would also create enormous geopolitical power and influence for nation-states that develop, deploy, and dominate the technology behind DLT applications involving autonomous sensors and 5G telecommunications technology. This influence would extend due to the integration of those technologies with direct peer-to-peer payments in their sovereign CBDC that supports micropayments for largely automated economic activity.

The US should thoughtfully consider what role it will play and to what degree its core values will be incorporated in the principles and design of this future system.

> **If the US dollar is to remain the world's primary reserve currency in the unfolding century, it cannot remain an analog instrument and unit of account for things increasingly denominated as digital tokens. It must itself become a digital tokenized currency that measures, supports, and transacts with the world's digital tokenized things of value.**

As was the case in the analog era, for the US dollar to remain a reserve currency, a US CBDC must carry longstanding US values of economic stability, individual liberty and privacy, free enterprise, and the rule of law into the digital age.

If payment systems could bypass Western banks heavily linked economically and geopolitically to US dollar reserves, the effectiveness of economic sanctions as a central and unifying tool of our foreign policy would be at serious risk. It would mean US global leadership, particularly in the exercise of soft power, would be at risk as well. Furthermore, if foreign central banks no longer need to maintain US dollar reserves to fund purchases in dollars, demand would decline for US government bonds, resulting in greater constraints on US fiscal policies and higher interest rates for the government and consumers.

The United States cannot take the US dollar's predominant status in the international financial system for granted. Along with the other key factor noted above, the dollar's primacy is at risk if it remains anchored in its analog state (inclusive of its manual processes and legacy infrastructure) while other leading central banks are advancing considerations for central bank digital currencies. If the dollar is to retain its preeminent role, it must remain up to date and technologically competitive.

In this time of great global economic uncertainty, the longstanding role of the US dollar as a source of global economic stability is essential. Thus, the US dollar needs to adapt to meet new digital functionalities that consumers, businesses, and governments increasingly demand. The status of US money domestically and abroad would, in large part, depend on whether the Federal Reserve can provide these new and needed functionalities in a digital world.

Unlocked opportunities with a digital dollar

The advent of a digital dollar would spark new industries and modernize existing ecosystems. Similar to how, decades ago, the internet and, more recently, the creation of smartphones and app stores heralded a wave of ingenuity, efficiency, and consumer centralism, a digital dollar would create opportunities for both new and existing players.

> **The programmable and customizable aspects of digital currencies could enable the private sector to offer varying privacy customizations, data ownership controls, transaction and treasury management efficiencies, and financial accessibility.**

Not only would a digital dollar create new markets, but also it would enable new players to enter established markets. The benefits of a digital dollar can be applied to niche industry demands and areas of risk. As market players gain access to the capabilities of a digital dollar, they could apply it to specific industries. A digital dollar would provide a modern currency architecture for the private sector to utilize and build upon.

Use cases

A critical point to reiterate about the introduction of a tokenized US dollar is that it would sit alongside the existing forms of money and would enhance competition and choice in financial service infrastructures. Thus, we do not expect it to materially change all existing processes but instead to drive benefits and unlock new opportunities in specific use cases. Below, we outline several initial use cases to which we believe a tokenized US dollar could add material value. Through engagement with stakeholders, the public sector, and our advisory group, we intend to refine these use cases further and identify potential pilots to test the value hypotheses and inform design decisions. The below is a summary; further details can be found in the Appendix.

Summary of use cases:

Category	Use Case	Impacted Stakeholders	Sizing	Hypothesized US CBDC Benefits (Qualitative and Quantitative)	Hypothetical Pilots
Domestic Payments	Peer-to Peer (P2P) Payments	Consumers (end users); commercial-banks; mobile payment providers	$310B transaction value (2019)[32]	Faster accessibility of funds Reduced cost of a mobile payment transfer Increased financial inclusion Increased speed and ease by which developers can build secure digital wallets	Work with policymakers and private sector in administering benefits and ensuring retailers are able to accept tokenized money Work with private sector in leveraging existing or creating low-cost digital wallets (to ensure access and economic viability)
	Domestic Retail Payments (Consumer)	Consumers (end users); commercial banks; retailers; mobile payment providers	$7.08T total card payments value in 2018[33]	Reduction of trapped liquidity Reduced need for intermediaries Additional consumer payment choice Introduction of cash-like treasury benefits Reduced verification costs	See above
	Domestic Retail Payments (Business)	Manufacturers; wholesalers; retailers	$25T B2B payment volume in the US in 2016[34]	Introduction of Fedwire-like benefits for non-Fedwire participants Introduction of finality of settlement Reduction of settlement risk	Work with targeted stakeholders within an ecosystem (e.g., agriculture supply chain)

[32]He, "Strong."
[33]The Federal Reserve, "2019 Payments Study."
[34]Mastercard, "New Opportunities."

Category	Use Case	Impacted Stakeholders	Sizing	Hypothesized US CBDC Benefits (Qualitative and Quantitative)	Hypothetical Pilots
Domestic Payments	Delivery Versus Payments (DVP)	Settlement & clearing systems; buyer; seller	Average US equities daily volume of 100M trades per day (2018)[35]	Introduction of settlement innovation, straight through processing, and efficiencies in risk and margin requirements	Work with clearing and settlement institutions to pilot DVP for tokenized assets
International Payments	Remittance Payments	Consumers (end users); commercial banks; banking intermediaries	$68.4B remittance outflows from US (2018)[36]	Ability to transfer funds without needing an intermediary Reduced costs to transfer funds Increased speed and efficiency for remittance payment processing	Develop a testing partnership in a targeted corridor between US and partner country (e.g., Mexico given the $30B in remittances sent from US to Mexico in 2019[37])
	Cross-Border Payments	Institutional payers and payees; correspondent banks; settlement agents	$136T in cross border payment flows (2018)[38]	Introduction of atomic settlement, trade oversight transparency, risk management, and interoperability Improved efficiency Enablement of front-end modular innovation Improved experience in niche trade corridors	See above
Government Benefits	Benefit Administration	Government agencies, consumers (end users)	52.2M benefit recipients in the US in 2012[39]	Streamlined, transparent, and expedited distribution of benefits Operational time and cost efficiencies	Partner with federal or state government agency in deploying benefits
	Exceptional Circumstances	Government agencies, consumers (end users)	125M COVID-19 relief recipients in 2020[40] $16.9B in FEMA aid for New York's Hurricane Sandy Recovery[41]	New ability to transfer riskless means of payment quickly and autonomously to households and corporations during times of crisis and national emergencies	See above

[35]DTCC, "DTCC announces."
[36]The World Bank, "Migration."
[37]Pew Research Center, "Remittance flows"
[38]McKinsey & Company, "Global Payments."
[39]United States Census Bureau, "21.3 Percent"
[40]Still et al., "Calculate."
[41]FEMA, "FEMA aid."

Conclusion

Throughout history, the United States has been a leader in innovation and building structures for future generations. A new technological age is unfolding, allowing for digitization of things of value to become tokenized, programmable, and decentralized. Across the globe, governments and private entities are experimenting with tokenized commodities, contracts, legal titles and, most critically, commercial and central bank digital currencies. This wave of digital token innovation is still gaining momentum.

The questions for the United States are what role it will play in this innovation and to what degree will its core values be brought to bear. If the US dollar is to remain the world's primary reserve currency in the unfolding digital century, how can it remain an analog instrument and unit of account for things increasingly programmable and denominated as digital tokens? Should it not also become a digital tokenized currency that measures, supports, and transacts with the world's digital things of value? Should the dollar not carry with it into the new digital age longstanding US values of economic stability, individual liberty and privacy, free enterprise and the rule of law? If not, is the United States willing to accept the values of its economic competitors imposed on the future of money?

We believe the United States should, and must, take a leadership role in this new wave of digital innovation. Furthermore, we believe the launch of a tokenized digital dollar is a logical and critical next step to future-proof the dollar, enshrine its democratic values in the future of money, drive societal and economic benefits, and unlock new policy tools. In summary, the Project considers our "champion model" to be a tokenized form of the US dollar that:

- **operates alongside existing monies**
- **is primarily distributed through the existing two-tiered architecture of commercial banks and regulated money transmitters**
- **is recorded on new transactional infrastructure, potentially informed by distributed ledger technology**

We believe that exploring a well-architected, durable, and universal digital dollar is in the national interest. Successfully creating it is an enormous undertaking and needs to be done carefully, thoughtfully, and deliberately. Something as complex and worthy of the US dollar's global importance should not be completed in a hurried manner. It will take time to get it right. Nevertheless, now is the time to get started. The Digital Dollar Project is here to assist.

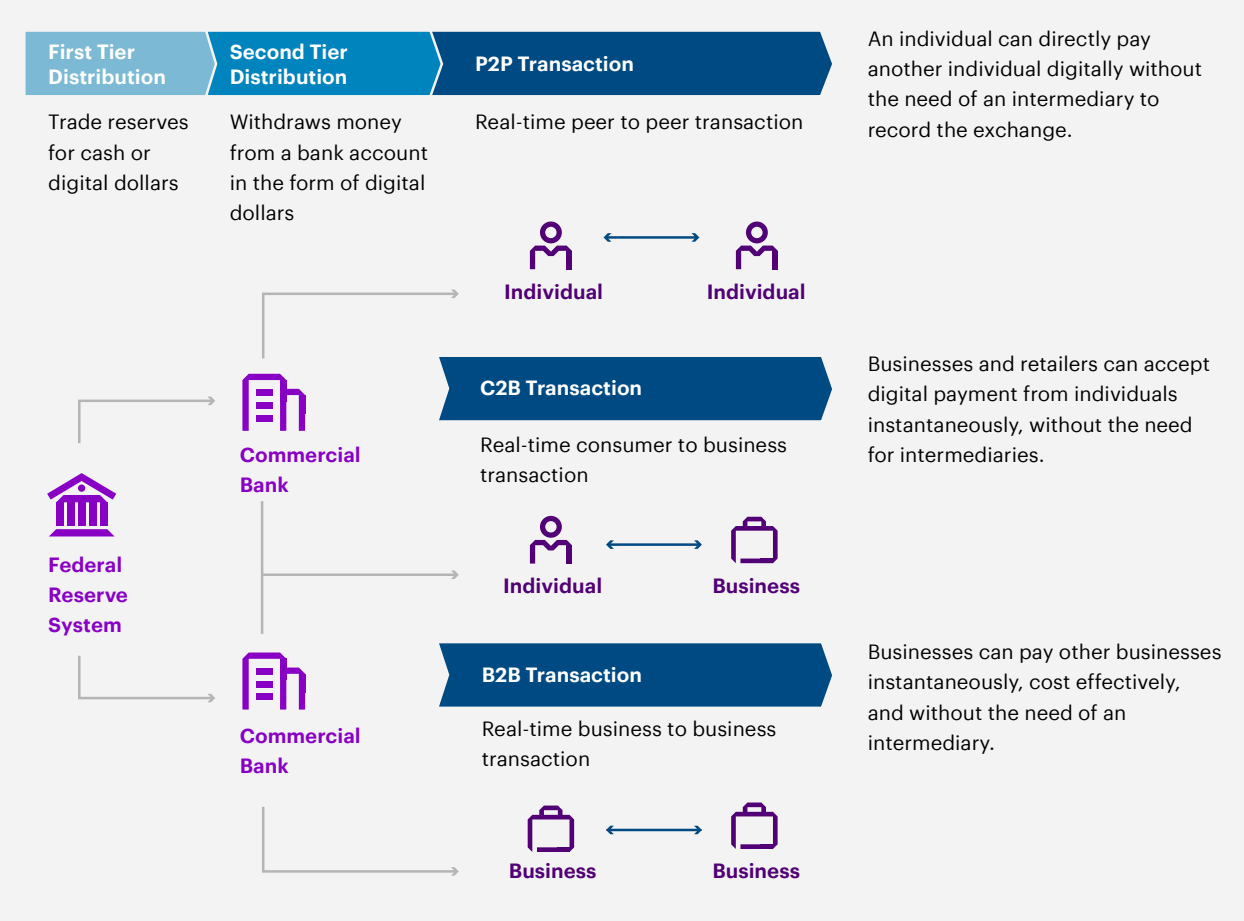
Next steps

In the near term, we will examine potential use cases and pilots to test the outlined hypotheses of our champion model and pivot to consider challenger models of alternative approaches as needed. We must ensure that the net benefits of the creation of a US CBDC outweigh its implementation challenges and risks. In addition, we anticipate hosting roundtable discussions with key constituent groups, both public and private, as we explore and refine the configurable design choices, opportunities, and unlocked value of a US CBDC. We welcome your comments and questions at feedback@digitaldollarproject.org as we continue our exploration of a tokenized US digital dollar.

Appendix

Domestic payments

Potential Digital Dollar Distribution and Domestic Transaction Model



Illustrative purposes only

Peer-to-Peer (P2P) Payments

As our economy became more digitized with more transactions occurring virtually, the private sector developed solutions for peer-to-peer (P2P) money transfers that overcame the limitations of physical cash. There has been a new wave of innovative message-based payment systems that have created faster transaction methods and improved user experiences. A digital dollar would leverage a fundamentally different architecture that could serve actual digital P2P transactions without the need for an intermediary to control a ledger. Over the past decade, P2P mobile payment services, such as PayPal, Venmo, and Zelle, have created faster and more direct methods of transferring funds. Despite their greater speed and convenience, such P2P mobile payment systems are still account-based, meaning the transactions are not fully complete or "final" and could still be reversed until their respective debit and credit transactions are recorded, reconciled, and settled.[42]

[42]This is not to imply that fraudulent, incorrect, or impermissible CBDC transactions are not reversible, but it speaks to the necessary risk and control processes needed to settle an account-based transaction.

In 2019, there were more than 69 million mobile P2P payment system users in the United States,[43] with an estimated total transaction value of $310 billion.[44] A transaction records in seconds, but it can take between one and five business days for the funds to be accessible, depending on the P2P system and the amount transferred.

A digital dollar could support a more natural P2P payment system that would resemble a physical, P2P cash transfer. Individuals would be able to send or receive payments almost instantaneously without the need for an intermediary. Although a CBDC direct transfer would serve some of the P2P volume, the mobile payment providers would be able to adapt to serve as wallet providers for digital dollars. The wallet provider would be able to design transaction and wallet size based on customer preferences and jurisdictional mandates. A desirable outcome of this development would be creating low-cost digital wallet services better able to reach unbanked populations.

As the benefits of a CBDC have become clearer to existing industry participants, they have begun to prepare for, and explore the use of, digital assets. A digital dollar brings many advantages to the electronic P2P infrastructure. The speed, efficiency, and ability to transfer a token directly allows for reduced time and costs associated with a P2P transfer. Through additional analysis and pilots, we will test the hypothesis that a CBDC could reduce the cost of a mobile payment transfer, which, in the case of Zelle, currently costs a participating bank between $0.50 to $0.75 per transaction.[45]

One design benefit offered by CBDC is the ability to customize the design options of payment transactions. Through careful and thoughtful explorations of privacy optionality, the US could implement select privacy controls such as anonymizing transactions under a certain value threshold. There is an opportunity for the US government to design a CBDC that protects users' privacy and gives the user control of how and with whom they share their personal data. The programmability and design choices for a digital dollar could provide better controls for how user data is collected and leveraged. Payment service institutions are currently recording and, in some cases, capitalizing on users' personal payment data.[46] The anonymizing elements of cash transactions could be reflected digitally in a tokenized digital dollar.

Domestic Retail Payments (Consumer)

A digital dollar would provide dynamic capabilities to the domestic retail payment landscape. The cash, debit, and credit infrastructures in the US are very sophisticated and are crucial payment channels, but each have their own tradeoffs.[47] There are merchants and consumers who prefer, and will continue to prefer, cash payments, given that they provide immediate liquidity without the need for an intermediary. However, physical cash has transport and storage limitations. The recent COVID-19 crisis further raises concerns about the public health implications of handling physical cash.[48] Furthermore, merchants could offer incentives in the form of discounts to encourage consumers to use CBDC versus other available payment methods.[49]

[43]He, "Strong."
[44]Ibid.
[45]Mulligan, "Zelle."
[46]Withers and White, "Dollars."
[47]Merchants and consumers may choose to continue using more traditional electronic payment methods for retail payments. The intermediary serves to handle disputes, provide fraud protection to both merchant and consumer, provide rewards to the consumer, and provide customer service.
[48]The US government was concerned about handling physical cash during the COVID-19 crisis. (Schroeder and Irrera, "Fed.")
[49]This assumes that consumers weigh the discount as more valuable than benefits offered by other methods like paying on credit or receiving purchase protection.

Electronic credit and debit payments provide broader access and optionality for consumers but create trapped liquidity throughout the settlement process for merchants who depend on bank intermediaries. Due to the limitations of cash and bank payments, retailers have begun to accept more innovative payment methods such as cryptocurrencies or digital payment options such as Venmo.[50]

With a CBDC, customers would be able to pay the retailer directly and instantaneously, for lower costs, and without the need of traditional intermediaries. A digital dollar would provide not only small businesses treasury benefits that cash currently provides, but also electronic access that does not require a banking intermediator to verify and settle the transaction. A CBDC could unlock transaction savings by providing an alternate payment method to debit, credit, prepaid card transactions[51] and cash payments which cost a retailer five to 15% of their annual revenue in cash-handling costs.[52]

A digital dollar would thus offer retailers, customers, and financial institutions a potentially more affordable and efficient payment method over existing cash and card payments.[53] Due to the cost savings that retailers would enjoy, retailers could incentivize the retail use of a digital dollar by offering discounts similar to when customers pay with cash in stores today.[54] Retailers would have faster access to money, as they would not have to wait anywhere from a few hours to five days for credit and debit payments to process.[55] The increased speed by which merchants receive and access funds would provide them with working capital benefits.

Domestic Retail Payments (Business)

An effective domestic payment system is critical in supporting American businesses; business-to-business (B2B) transactions occur between manufacturers, wholesalers, and retailers for the production and sale of goods and services. Most B2B payments are made using checks, credit, or debit transactions, or systems like Fedwire or Automated Clearing House (ACH).[56] The innovation of a CBDC rests in allowing businesses to transact in central bank money, which guarantees finality of settlement, which in turn removes counterparty risk. This would enable non-Fedwire market participants to experience Fedwire-like benefits without opening additional Fed accounts, which has been explored by policymakers.[57]

Businesses are looking for more immediate, transparent, accessible, and secure methods of making payments to other institutions. CBDC would unlock a tier of benefits, including a faster, more secure method of B2B payments and instantaneous settlement to a broader participant base. Leveraging an existing CBDC could unlock an additional tranche of innovation, including improved treasury management, financing analytics, liquidity, and security measures.

Although a CBDC would serve as an architecture for B2B payments, the Project does not intend to disrupt current global initiatives to implement RTGS systems. There have been intentions for

[50]Nasdaq, "7 Major Companies."
[51]In 2018, debit, credit, and prepaid card transactions cost an estimated $154.72 Billion to merchants. (Derived calculation [The Federal Reserve, "FRPS Initial Data Release"] using average credit card, debit card processing and interchange fee [Resendiz, "Credit."])
[52]Buzek, "Cash."
[53]The design and inclusion of consumer protection frameworks will be critical in assuring consumers of the various protections they have come to expect from other payment methods.
[54]Federal Trade Commission, "New Rules."
[55]Johnson, "The Merchant's Guide."
[56]Checks and ACH transfers were the most common types of B2B payments. In 2018, 47% of B2B payments were made by paper check, compared to 34% via ACH and 13% via bank wires. Only 6% were made by credit card (Bustos, "The state.")
[57]It is worth noting that policymakers have explored individual Fed accounts despite it being currently prohibited by law.

the Federal Reserve to enable a more accessible and efficient payment rail through their FedNow Initiative, built on traditional technologies. The need to improve a domestic payment solution is already being addressed by the FedNow service and is not the driving force behind US CBDC.

Delivery Versus Payment (DvP)

From humble beginnings in Philadelphia, the US securities industry has been a leader in innovation globally, including the launch of the world's first fully electronic exchange, NASDAQ (1971) the establishment of the DTCC (1973), and the eventual dematerialization of securities. The continuous innovation by the New York Stock Exchange (NYSE), NASDAQ, and exchanges globally have increased market efficiency, access, and durability during volatile times. While exchanges in the US continue to innovate and adapt for the benefit of market participants, CBDC represents a fundamental shift that unlocks previously unattainable capabilities for settlement, straight-through processing, and reduction in risk and margin requirements.[58]

CBDC can provide an important mechanism for innovation that reduces risk and increases efficiency in the US securities industry. Settlement of securities currently occurs using DvP, meaning that delivery of a security occurs if, and only if, payment occurs.[59] We emphasize that DvP does not imply instant settlement, nor does it imply atomic settlement.[60] There are three models of DvP that differ primarily on the time of settlement (obligation by obligation or net basis) and result in different potential credit risks that are today mitigated by central securities depositories (CSD):

Model	Securities Settlement	Payment Settlement	Potential Credit Risk
Model 1	Gross	Gross	No
Model 2	Gross	Net	Yes
Model 3	Net	Net	Yes

Model 1 provides simultaneous settlement of both individual securities transfers and associated funds transfers, usually by maintaining funds accounts for participants and making all transfers by book entries.[61] Transactions become final on an obligation-by-obligation basis, thus reducing credit and liquidity exposure. A disadvantage of Model 1 is that it can require potentially large amounts of liquidity from participants since the full principal value of each transaction must be covered.[62]

Participants require eventual final settlement of payment to occur in nothing less than Federal Reserve backed money, which digitally can only occur in reserve accounts. CBDC in a Model 1 system provides the most benefits of programmable money coupled with digital securities,

[58]The DTCC estimates that "on average over $5 billion is held in margin to manage counterparty default risk..[with] additional liquidity resources for peak settlement days..."(DTCC, "Modernizing.") Additionally, the current settlement failure rate of 2% accounts for about $3 billion in losses every year (McNeil, "Eliminating.")

[59]BIS and OICV-IOSCO, "Principles," 8.

[60]"Atomic settlement" means "that the transfer of two assets is linked in such a way as to ensure that the transfer of one asset occurs if and only if the transfer of the other asset also occurs—that is, settlement is conditional." (Bank of England and RTGS, "Call," 1.)

[61]BIS and OICV-IOSCO, "Principles."

[62]Ibid.

allowing true gross atomic settlement. While other forms of value, including private currency or commercial bank money, can be used as the payment leg, those forms introduce counterparty risk that would not otherwise exist when using a CBDC.

Model 2 provides simultaneous settlement of only securities, while associated funds transfer occurs on a net basis. Securities are held on an account-basis by the entity providing securities settlement and settled by a book entry, while fund accounts can be maintained by a different entity, including a commercial bank or a central bank.[63] The primary advantage of Model 2 is that it requires significantly less liquidity for settlement as compared to Model 1. The primary disadvantage is that it introduces risks due to the delay in settlement finality, which only occurs when payment is final.[64]

Instead of using payment systems like CHIPS or Fedwire, which are not widely accessible, settlement could occur using CBDC, providing more inclusive accessibility. Such accessibility, easier reconciliation, and other features could unlock innovation that allows more frequent net settlement to more participants than the current mechanisms, thereby reducing credit risk and costs.

Model 3 provides the simultaneous net settlement of both securities and funds.[65] Like Model 2, settlement and fund accounts can be held by two separate entities. The primary benefit of Model 3 is that the book-entry transfers of the securities and funds only occur at the end of the processing cycle.[66]

Like Model 2, CBDC in a Model 3 system could provide the payment leg for final settlement. This could again provide increased accessibility, easier reconciliation, and spur innovation.

Overall, while innovation in the securities settlement space can occur with other forms of payment, we believe that CBDC could provide benefits that exceed the current settlement mechanisms. Settlement in a form other than central bank money would be a step backward that could introduce systemic risk in the securities and financial system.

International payments

Remittance Payments

Remittance payments from individuals play a massive role in the US financial ecosystem. In 2018, the total value of remittance payment outflow from the US reached a record high of $68.4 billion.[67] Remittances can be sent via a money transfer service (e.g., Western Union) or an electronic payment system (e.g., wiring through a bank). Remittances are commonly sent by foreign-born non-citizens and foreign-born citizens, of which, 47.2% and 28.1% respectively are un- or underbanked.[68] This population of immigrants is typically excluded from participating in traditional financial services and thus rely on alternative financial services with high fees.

[63] Ibid.
[64] Ibid.
[65] Ibid.
[66] Ibid.
[67] The World Bank, "Migration."
[68] Foreign-born citizens were 4.8% unbanked and 23.3% underbanked. Foreign-born non-citizens were 16.2% unbanked and 31.0% underbanked. (Apaam et al., "2017 FDIC.")

Remittance payments are often exchanged into local currencies for making purchases.[69] The flow and usage of dollars into foreign countries often coincide with periods of financial unrest, including periods of high inflation, where countries turn to a dollar-denominated informal market instead of using their local currencies.[70] A potential design choice could allow end users receiving remittances to transact outside of the US for regular shopping needs. Simultaneously, another design choice could allow for the digital dollars to be held, or stored, as needed. Depending on the CBDC architecture, the system could allow for individuals to transfer funds abroad directly without needing an intermediary. In cases where an intermediary is required, reconciliation and manual intervention could still be reduced and therefore decrease the cost to transfer funds. This improves safety, efficiency, and cost for individuals moving and using dollars around the world.

Improving the ease of access to dollars abroad strengthens the use of the dollar abroad and provides benefits for countries who use the US dollar as their currency or peg their currency to the dollar.[71] Unlocking faster remittance payments could help disaster relief efforts, raise the living standard abroad, and address global poverty. By lowering the costs and time of remittance transfers, a CBDC can widen bank access to the unbanked population while keeping transaction costs very low and simultaneously profitable for banks.

Cross-Border Payments

As the world has become more globalized, cross-border and multicurrency (CBMC) payment systems have developed to support international commerce, primarily for B2B uses. Cross-border payments are where the payer and payee are in different jurisdictions and are debited and credited in different currencies. Cross-border payments have historically been slower, more complex, less transparent, and more expensive than domestic payments. They are usually executed though chains of correspondent banks[72] or the use of a dedicated cross-border or multicurrency payment system.[73] CBMC payment systems have developed to provide more efficient and timelier cross-border transactions in specific, high-volume payment channels. CBMCs have gone through major advancements and expansions over the past 20 years, and there are still plans to introduce new CBMCs in the next few years, as manufacturers expand their supply chains internationally. The dollar remains the most commonly used invoice currency, with many commodities priced in USD. Internationally, digitizing the dollar as a CBDC, would significantly reduce complexity and improve cross-border trade.

A digital dollar would provide many of the capabilities that are being sought after with current CBMC initiatives, including automatic settlement, trade oversight transparency, risk management, and interoperability. These added benefits to international trade improve the

[69]Remittance payments can also theoretically be kept and maintained in US dollars.
[70]Winton, "Shining."
[71]We recognize that increased international dollarization could present unique policy and economic challenges that require further exploration.
[72]SWIFT, "SWIFT GPI."
[73]Bech, "Payments without borders."

efficiency of cross-border payments, enable front-end modular innovation, and improve the user experience in niche trade corridors. With a digital dollar, parties in the same international jurisdiction could settle in USD without needing a settlement agent who has access to the US payment system to net positions. A digital dollar would serve as a platform for innovative private-sector systems to manage cross-border single and multicurrency transactions that involve the US dollar.[74]

Government payments

Government Benefit Administration

According to the US Census Bureau, the US government routinely sent assistance to approximately 52.2 million people each month in 2012.[75] Under normal circumstances, the distribution of government benefits administered under both mandatory and discretionary spending[76] typically are managed and distributed well.[77] In exceptional circumstances, however, the government lacks an autonomous method (i.e., outside of the existing commercial bank system) to provide central bank money instantaneously to targeted recipients: consumers, households, and corporations.

Direct payments, excluding tax-related payments,[78] to Americans have historically only been used in times of financial distress. For example, during the 2008 financial crisis, President George. W. Bush signed a law on February 13, 2008 to send direct payments to Americans, but it was late April before money, in the form of physical checks, was sent. Payments were largely complete by the following summer, after a few months.[79]

The inefficiencies in distributing emergency financial support promptly and effectively have been highlighted during the COVID-19 crisis. The government currently lacks the ability to distribute benefits with autonomous settlement and minimal transaction risk. A tokenized US digital dollar could provide instantaneous distribution of central bank money through the introduction of an additional, autonomous payments infrastructure for distribution of government benefits. For government agencies charged to distribute government crisis benefits to needy people, especially those without access to banking services, direct transmittal of digital dollars to mobile devices may be a timesaver.

[74]BIS, "Cross-border."
[75]United States Census Bureau, "21.3 Percent."
[76]"Mandatory and discretionary spending account for more than 90% of all federal spending and pay for all of the government services and programs on which we rely." The remaining 10% includes interest on debt, the interest the government pays on its accumulated debt, minus interest income received by the government for assets it owns. (National Priorities Project, "Federal.")
[77]Mandatory programs such as income support programs (e.g., Unemployment Compensation, Child Nutrition, etc., and retirement and disability programs for civil servants, the Coast Guard, and the military) total $645B. (Amadeo, "Current.")
[78]2020 tax-related direct deposits are estimated to be 60 million through leveraging 2018 or 2019 IRS tax return information. There were an estimated 140 million taxpayers in 2017. Nearly half of the direct payments distributed to Americans in 2020 due to COVID-19 will therefore be mailed via check, a process expected to take as long as 20 weeks, as the IRS has capacity to issue about five million checks per week. (Frankel, "Stimulus," and York, "Summary.")
[79]Rubin, "The Government."

For example, the Supplemental Nutrition Assistance Program (SNAP) is a mandatory government program that provides eligible people with benefits cards, typically plastic electronic benefits transfer (EBT) cards, to buy food at authorized grocery stores and farmers markets. EBT is an electronic system that allows a recipient to authorize the transfer of their government benefits from a federal account to a retailer account to pay for products received.[80] Roughly 38 million people, or 12% of Americans, participated in SNAP in 2019.[81]

In exceptional circumstances, government benefit administration of SNAP could be streamlined and expedited through the distribution of a CBDC, or digital dollars, to an end user's digital wallet instead of an EBT card.[82] Reducing SNAP's distribution time ensures that the benefits will get into the hands of those who need it as quickly as possible. Payments could occur through conventional terminals, thus causing limited disruption to end user and retailer experiences. Commercial banks could extend such wallets to existing customers through existing mobile applications covering KYC/AML provisions. For the un- and underbanked, P2P providers, FinTechs, or even telecom providers could adapt to provide digital wallet services at a lower cost.[83] Those wallets could then be leveraged by dedicated agencies based on set eligibility criteria and requirements to receive benefits in the first place.

The identification of those who receive benefits in the form of tokenized digital dollars would leverage existing, readily available information on targeted end users and be managed by existing government agencies. Although the end users or benefit recipients may not recognize the full advantages of CBDC, the government would experience time and cost savings from efficiently targeting and distributing funds to recipients. Looking forward, there are a variety of Government-to-Person (G2P) and Person-to-Government (P2G) payments (e.g., student loan payments, municipal payments, etc.) that could be made more efficient by a tokenized digital dollar and whose positive effects could be experienced by all payment participants.

[80]USDA, "What."
[81]Nchako, "A Closer."
[82]Today, generally, it takes up to 30 days to receive the first EBT card, whereas expedited/emergency SNAP is dispensed to those who qualify within seven calendar days. (gettingsnap.org, "FAQs.")
[83]Developer-friendly "open source API" would lower the barriers to entry to creating digital wallets and thus provide the creation of a product geared toward those who are financially underserved today.

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About the Digital Dollar Project

To help launch the Project, J. Christopher and Charles H. Giancarlo and Daniel Gorfine have formed the Digital Dollar Foundation (The Foundation), a not-for-profit organization supporting the Digital Dollar Project's efforts to advance exploration of a United States central bank digital currency. The Honorable J. Christopher Giancarlo is Senior Counsel to the international law firm Willkie Farr & Gallagher and the former Chairman of the US Commodity Futures Trading Commission (CFTC). Charles Giancarlo is the CEO of Pure Storage (NYSE: PSTG) and formerly served in senior executive roles at Cisco Systems (Nasdaq: CSCO) and Silver Lake Partners, the private equity firm. Daniel Gorfine is founder and CEO of Gattaca Horizons LLC and previously served as the CFTC's first Chief Innovation Officer and Director of LabCFTC. Visit us at www.digitaldollarproject.org.

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